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Probabilistic modelling for forecasting the wind energy resource at the seasonal horizon

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We build and evaluate a probabilistic model designed for forecasting the distribution of the daily mean wind speed at the seasonal timescale. On such long-term timescales, numerical weather prediction models can bring valuable information on the large-scale circulation of the atmosphere which strongly influences surface wind speed. As an example, variations in the position of the storm track over the Atlantic directly impact surface winds in the North of France in autumn and winter.

The model aims at predicting the daily mean wind speed distribution knowing the large scale situation of the atmosphere which is summarized by an index derived from the multi-polynomial regression between the 10 first Principal Components of the 500hPa geopotential height and the daily mean wind speed. The conditionnal probability density function of the wind speed knowing the index is estimated by a gaussian kernel density estimation over 20 years of daily reanalysis data.

Evaluating the probabilistic model on a validation period of 15 years, we show that it is at least as well calibrated as the seasonal climatology which can be taken as a first guess prediction at such long-term horizon. We also show that the model is 20% sharper than the climatology in average, due to a less pronounced seasonal variability of the confidence interval width. We use the ECMWF seasonal forecast ensemble in order to predict the daily mean wind speed distribution at the seasonal timescale. The ensemble forecast, from which the index is derived, displays a growing uncertainty with time leading to an increase of the confidence interval width predicted by the probabilistic model. We show that the model remains sharper than the climatology at the monthly horizon, but tends to the climatological interval width after 30 days.